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AUTHOR Turoff, Murray; And Others
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ABSTRACT

Since the early 1980s the evolution of computer mediated communications (CMC) systems designed to support collaborative work has been characterized by two trends. One is the proliferation of new systems to take advantage of technological changes; the second is the incorporation of functionality into highly specialized or tailored application oriented systems. TEIES (Tailorable Electronic Information Exchange System) at the New Jersey Institute of Technology is an example of such a system. It has been designed to be integrated with other computer resources and to allow individuals and groups to tailor the system to their application needs. It is also designed to serve the frequent user who is using CMC for a significant part of his or her daily communications. The TEIES effort represents a new generation of CMC software that will allow the design, development, and evaluation of tailored collaborative systems. It provides the toolbox to overcome the tremendous programming bottleneck present in the development of collaborative systems. The forms-based interface for TEIES and the open ended concepts of privileges, roles, activities, group sharing, and notifications allow change to the interface or to the basic metaphor of the communications process and associated list processing. (2 figures and 24 references) (EW)

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Computer Mediated Communications and Tailorability

by

Murray Turoff, John Foster, Kenneth Ng, Kevin Walsh & Gurinder Singh Johar

Computerized Conferencing and Communications Center
New Jersey Institute of Technology
Newark, N.J. 07102
Tel: 201 596 2929

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EXTENDED ABSTRACT
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Abstract:

This paper provides an overview of the tailorability features desirable in CMC systems to support Collaborative Work. It uses the current design of TEIES (Tailorable Electronic Information Exchange System) as an illustration of how such functionality is actually incorporated into a system. Significant acknowledgment is given to David Morris of IBM who contributed to many of the design concepts covered in this paper.

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INTRODUCTION

In the decade following the first computerized conferencing system (Turoff, 1972) there were only about ten general purpose systems implemented. Among the early systems were EMISARI, FORUM, EIES, KOM, NOTEPAD, PARTI, CONFER, and EQUAL (Hiltz & Turoff, 1978; Kerr & Hiltz, 1982; Rice, 1984). These systems were distinguished from message systems in that their primary orientation was toward communications to support groups tasks, and their internal design was based upon central data bases of these group communications.

These systems demonstrated a wide variety of alternative designs. Even with these differences, each of these systems, or their derivatives, has had many application successes (Kerr & Hiltz, 1982). Design differences included such fundamental considerations as how to organize and deliver new discussion comments to the individuals in the group. For example, three very different forms of delivery were linear chronological transcripts (e.g. EIES, FORUM), tree structured transcripts (e.g. PARTI), and inquiry-response structuring (e.g. CONFER). In general, these delivery design choices produced significant differences in the behavior of communicating groups and in the types of applications the systems seemed best suited for (Kerr & Hiltz, 1982). The unlimited branching structure of PARTI allowed very large groups (hundreds) to share information, but tended to fragment the activities and cohesion of small working groups. The inquiry-response structure generates more quick reactions and shorter text items, while the linear structure encourages delay in responses and generates larger, more reflective responses.

Since the early 80's the evolution of Computer Mediated Communications can be characterized by two trends. One is the proliferation of new systems to take advantage of changes in the technology. This includes systems which operate on powerful micros and

minis and in network environments. As micros become more powerful, bulletin board systems are beginning to evolve into conferencing systems. Message systems have also attempted to incorporate group oriented facilities.

Another significant trend is the incorporation of communication functionality into highly specialized or tailored application oriented systems. There is, for example, a growing number of Hypertext systems, designed for very particular applications (Garg, 1987; Lowe, 1985; Trigg, 1986), which have incorporated structures for contributions of material to the data base by groups of individuals. In fact, a recent hypertext policy analysis system (Conklin & Begeman, 1987) implementation is very much a replication of the first computerized conferencing system (Turoff, 1972). The area of Group Decision Support Systems (Bahgat 1986; DeScanctis, 1987; Scher, 1981) also illustrates the same specialized tailoring.

As a result "collaborative systems" are being developed either as systems oriented toward generalized communication systems, or as highly specialized systems tailored for specific applications. We have always been of the view that group oriented systems need to be tailored to the nature of the group and its application (Hiltz & Turoff, 1978, 1981, 1985; Hiltz, 1986; Turoff, 1985; Turoff & Hiltz, 1982). However, users cannot deal with numerous different systems to match different communication objectives. The challenge for the next generation of "collaborative systems" is integrated systems that raise the process of tailorability to the user interface level.

This paper presents an overview of the of TEIES (Tailorable Electronic Information Exchange System) at NJIT. TEIES has been designed to be integrated with other computer resources and to allow individuals and groups to tailor the system to their application needs. It is also designed to serve the frequent user, who is using Computer Mediated

Communications for a significant part of his or her daily communications.

TAILORABILITY DIMENSIONS

The primary factors that underlie the concept of tailorability for Computer Mediated Communications and Collaborative Systems are:

- Alternative group communication structures and protocols for different group communication needs, based upon the application, size of the group and the nature of the group.
- Alternative methods of organizing, tracking and integrating the resulting "database" of communications on an individual and group basis.
- Specific software support for alternative human roles that occur and are required for facilitating group communication processes.
- Integration into the communication processes of any required type of computer resources or support.
- Tailorability of the interface to satisfy individual cognitive and collaborative metaphors.

DIRECT AND INDIRECT METAPHORS

We agree very whole heartedly with Carroll and Thomas (1982; Chandraskearan, 1981) that metaphors are not merely a method of facilitating learning, but must also be viewed as a psychological model that underlies user interface design. It is quite natural to utilize the human communication metaphor for a collaborative system; however, we have extended this to utilize the communication metaphor to incorporate the utilization of any computer resource or functionality made available to the group or the individual. The same processes whereby individuals communicate with other humans provide the ability to utilize data bases, models and other computer based resources. Use of the same metaphor cuts through the problem of "system opacity" (Brown, 1985). This merger of any computer facilities into the Collaborative System means complete tailorability of both communication and information resources into a single integrated interface.

The user of TEIES deals with the choice of the type of object (See Figure I) he or she wishes to deal with, the choice of modifiers which result in choosing a specific subset of the chosen objects or a "list,"

Figure I: TEIES OBJECTS AND RELATIONSHIPS

DIRECTORY: A database of primary objects

lists:	members, groups, and conferences
indexes:	names, locations, ownership, roles, interest keys for members and groups, topic keys for conferences

MEMBERS: An authorized user of the system

owner of:	conferences and groups
author of:	messages, conference comments
creator of:	activities and notifications
possessing:	private files, indexes, lists of marked and authored items
described by:	interest keys, description, addresses, roles and memberships

GROUPS: A set of members that may act as a "super" member for the purposes of collaboration.

owning:	conferences and group mail
having:	membership and special roles for group members
allowing:	shared group files, indexes, and lists
described by:	topic keys, description and membership

MAIL & MESSAGES: A central cyclic database of messages sent between and among members and groups.

allowing:	attachment of activities, modification, retrieval, copying
indexed by:	keys, authors, receivers, date-time, replies
triggering:	notifications

CONFERENCES & COMMENTS: A structured discussion space treated as a database.

owned by:	member or group
having:	membership and roles, structures and protocols
allowing:	activities attached to comments
indexed by:	comment keys, authors, date-time, association

ACTIVITIES: Executable programs and forms that may be attached to text items to carry out an open ended variety of collaborative procedures or interfaces to other computer and information resources.

allowing:	voting, documents, memberships, conditional actions, programs, etc.
triggering:	tailored notifications

NOTIFICATIONS: Short notices delivered to a member's personal file space.

conveying:	alerts, closure confirmations, reminders, notice of transactions, canned messages, etc.
allowing:	direct retrieval and manipulation of objects
providing:	a tracking oriented database

Figure II: HOMEBASE AND CASUAL SCREENS

```
TEIES HOMEBASE                Screen 1 of 1              Screen code: 000

Objects:                          New:    Modifiers:

1.   Notifications:                #    1.   New    items
2.   Mail/Messages:                #    2.   Marked items:       #
3.   Conferences:                   #    3.   Item          categories
4.   Directory                          4.   Reception     categories
5.   Member  information                5.   Distribution  categories
6.   Group   information                6.   Types         of items
7.   Control information                7.   Status        of items
8.   Special systems                    8.   Parts         of items
                                        9.   Ordering      of lists

OBJECT CHOICES? _____________      MODIFIER CHOICES? _____________

Actions:

View  Find  Review  Create  Modify  Do   Organize     Help     (?/f1)
1.    2.    3.      4.      5.      6.   7.           Quit (--/quit)
ACTION CHOICE? ____________________________
```

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TEIES CASUAL                  Screen 1 of 1              Screen code: 000.C

                                                  number
View: NEW notifications ? y_                        #
      NEW mail          ? y_                        #
      NEW conferences   ? y_                        #
      MARKED items      ? n_                        #
      UNDONE activities ? n_

                                                  Optional fill in:
Enter:  conference      ? n_      Member/Group(s) ? _______________
Create: notification    ? n_      Message         ? _______________
        message         ? n_      Conference      ? _______________
        comment         ? n_         Comment      ? _______________
        draft           ? n_      Scratchpad      ? 1__
Modify: any item        ? n_      Index key       ? _______________
Find:   members         ? n_      Name/label part ? _______________
        groups          ? n_      Modifier        ? _______________
        messages        ? n_
        conferences     ? n_

ESC/PA1 = get control menu
Command? ____________________________  Screen PgUp/PgDn (f7/f8)
```

and the choice of a "generic" action which establishes a "work mode" for the user. The result of the three simultaneous choices is a list of specific objects to process (e.g. VIEW NEW MAIL). The user is then provided a tailored set of alternative actions that can be applied to any entry on the list or to all entries. Internally, the user has chosen a user state that produces a list and a set of processing alternatives to act on the list. It is possible for the more knowledgeable user to directly evoke the concept of list processing. Different lists from different user states may be manipulated in a general list processing approach.

The "list processing" metaphor is the general indirect metaphor which is also an underlying capability for which we wish the user to evolve an understanding. In part, this understanding is initiated by providing each user and group with the ability to "mark" items, which results in a stored list that may be called up for later processing. The benefit of this approach is the ultimate ability of users to manipulate and organize both their communications and the results of other computer facilities through a single interface structure.

The primary interface to TEIES is provided by either the HOMEBASE (See Figure II) screen which is the top level list of OBJECTS, MODIFIERS and ACTIONS available to the user, or by the CASUAL screen which represents a majority of the day to day tasks of a user. Both screens provide versions of a "control panel" approach which enables the user to specify their strategic interaction choice.

GENERIC COMMANDS AND ACTION MODES

The user is provided seven generic commands which may be applied to any object or collection of objects. The exact meaning of each command is a function of the state the user is in and the type of objects they are applied to. For each generic command, there are available more specific commands that carry out very specific actions. However, the system always

picks the expected default if the user chooses the generic version. This set of generic commands is:

Command	Generic Explanation
VIEW	Display individual objects or lists of objects (e.g. SCAN headers, GET whole items).
FIND	Provide search options appropriate to the object type.
REVIEW	Provide summary information such as distribution of items and activity.
CREATE	To create new objects.
MODIFY	To modify existing objects.
DO	To trigger the execution of activities associated with a given comment or message.
ORGANIZE	To perform various housekeeping functions provided for objects (e.g. INDEX items, MOVE items, etc.).

The use of a generic action approach means the user does not have to learn a new functionality to be able to deal with tailored and specialized capabilities.

ROLES, PRIVILEGES, AND TICKETS

The definition of a role on TEIES is based upon a combination of the fundamental internal privileges allowed for the role and the object to which the role is linked. There are over 25 privileges defined which are based upon the types of conditional communication actions individuals can take in day to day situations (e.g. placing material in someone's file without being able to see what is there). Roles are defined to be meaningful metaphors at the user level and are open ended in that it is quite easy to introduce new roles and privileges as needed. Some of the special roles are:

OWNER: The owner is the only one allowed to destroy an existing object, set or update various structuring parameters, and establish certain primary roles such as monitor.

MONITOR: A monitor is linked to a membership list and the monitor can add or remove members from the membership list as well as assign allowed roles.

INDEXER: This is a role that may be linked to any index, which permits

a person to modify both the index terms and the links to objects associated with the index terms.

CONTRIBUTOR: Cannot view objects but can contribute new objects.

MASQUERADER: This person is linked to an object as a regular member, but under a pseudonym rather than the persons real identification.

ORGANIZER: An organizer is someone who can create those allowed activities that cannot be created by regular members of a given conference or group.

Tickets are a mechanism whereby any member may convey specific privileges they have to another member. For example, a ticket may be issued by a an author to the allow the modification of their text item by someone who does not normally have that editing privilege. A ticket may be made conditional on such parameters as number of times it can be used, or the time period during which it is valid. The person issuing the ticket may also withdraw it at any time.

The associated concepts of privileges, roles and tickets are completely open ended and allows for the future expansion and tailoring of the human communication protocols.

CONFERENCES

The core of any collaborative system is the shared group discussion space. Over the years, many specific computer mediated conferencing structures have been evolved for specific purposes. A great deal of the variation among these structures can be accounted for by such parameters and functionality as the sizes of allowed root items and replies, organization and conditions place upon the entry and delivery of text items, voting procedures, roles of humans within the group and conference, indexing alternatives, and the incorporation of specialized data structures and hypertext like linkages between text items. In TEIES all these features have degrees of tailorability which may be selected by the person creating a conference for a specific application.

Their are seven default conference structure choices that a beginning user may select from when establishing a conference, which will

automatically set parameters according to system wide settings. These are:

Discussion Conference: The discussion conference is structured to optimize general purpose discussion by active groups of up to fifty or more individuals.

Seminar Conference: This is designed to facilitate learning oriented seminars and the "Virtual Classroom" (Hiltz, 1986). It has such special activities as "response branches" where a member cannot see the answers of others to a question until he or she has supplied an answer or opinion.

Information Exchange: This structure is optimized for very large groups (hundreds) engaged in unpredictable information exchange. It allows a high degree of branching, careful indexing, and self selection of what sub-branches to track.

Project Management: This version incorporates various tracking, selection, and organizing features to maintain awareness of modifications, milestones, status, and task assignments that are taking place.

Composition Notebook: This version allows a high degree of selective roles in different designated portions of the conference, and tracks the updates and changes being made to the generation of a collaborative document.

Data Collection Conference: This is designed for the organization of structured data, and the tracking and validation of data changes for a group building and utilizing a collaborative data base.

Simulation-Game Conference: This is structured to allow a group to carry out a role playing, event oriented scenario game. It allows the game director to control allowed communication channels and the conditions and timing for events to occur and actions to be taken.

TEIES INTERNAL TAILORABILITY

TEIES is composed of four virtual machines (i.e. Master, Data Base Server, User & Network). A single TEIES system consists of one Master and any number of other machines. Each machine may reside anywhere on a network of independent computers and workstations. This means complete tailorability, in a system sense, of what is at any processor in the network and of the user workstation on an individual bases. The master server only verifies authority to establish communication channels between different machines. The principal internal features that allow tailorability are:

The TEIES database is an object oriented data base with members as defined objects. Since the data base contains the privileges as a form

of linkage attribute between the users and the objects they are working on, no application program or interface tailoring has to be concerned with the protection and security of the data involved. This also means that an application written in any language as an independent application can call on or be interfaced to TEIES.

TEIES incorporates its own forms subsystem which utilizes the proposed Standard Generalized Markup Language (SGML, Coombs, 1987). The forms subsystem has extensions that contain all the interface to TEIES, and are stored as text objects in the system. This reduces the design of interfaces to more of an editing task than a programming task. Forms may also be used to call up and execute programs available through the executive system in which TEIES resides.

Activities are designed in forms and may be attached to any text item. Activities can include executable programs or procedures. Users of TEIES can "do" any of these activities as well as "viewing" the text object to which they are attached. Activities, as a general extensible concept, can be used to integrate any application tool from any language or database into a given collaborative system design. Associated with activities are "notifications," which is a general transaction tracking and alerting system that can be linked to any activity.

TEIES provides two way linkages among data objects. Therefore, if a user wishes to link another user's material into an item, the original author will have references to that linkage in his data. This allows for experimentation with many protocols to handle the sharing of material among groups and is critical to working with group hypertext applications.

A TEIES user object and group object are equivalent in that they both have the same functionality. As a result groups may share any of the functionality provided to an individual.

Personal TEIES is a workstation-based graphics editor and display system. Graphics are coded in NAPLPS and linked to other objects in TEIES via GML. The result is that any graphics produced by one individual on the system may be manipulated and edited by another at a macro level as opposed to dealing with bit mapped representation. Icons in PERSONAL TEIES are higher level objects that may link in text and programs. Individuals and groups may create and share icons and what they link to. The result is that any icon may become a window or direct manipulation link to anything in PERSONAL TEIES or TEIES.

All software development work is in C and all systems are designed to isolate and restrict hardware and executive system dependencies to an OSI kernel (Operating System Interface). Programming standards have been imposed to make the code operational across a wide range of C compilers. This makes the system software easily transportable to different hardware and operating systems.

SUMMARY

The TEIES effort represents a new generation of CMC software that

will allow the design, development and evaluation of tailored collaborative systems. It provides the toolbox to overcome the tremendous programming bottleneck present in the development of collaborative systems. Everything has been done to minimize the human effort needed to create a tailored system. The forms based interface for TEIES and the open ended concepts of privileges, roles, activities, group sharing, and notifications allow the incorporation of tailored facilities without any fundamental change to the interface or to the basic metaphor of the communications process and associated list processing.

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